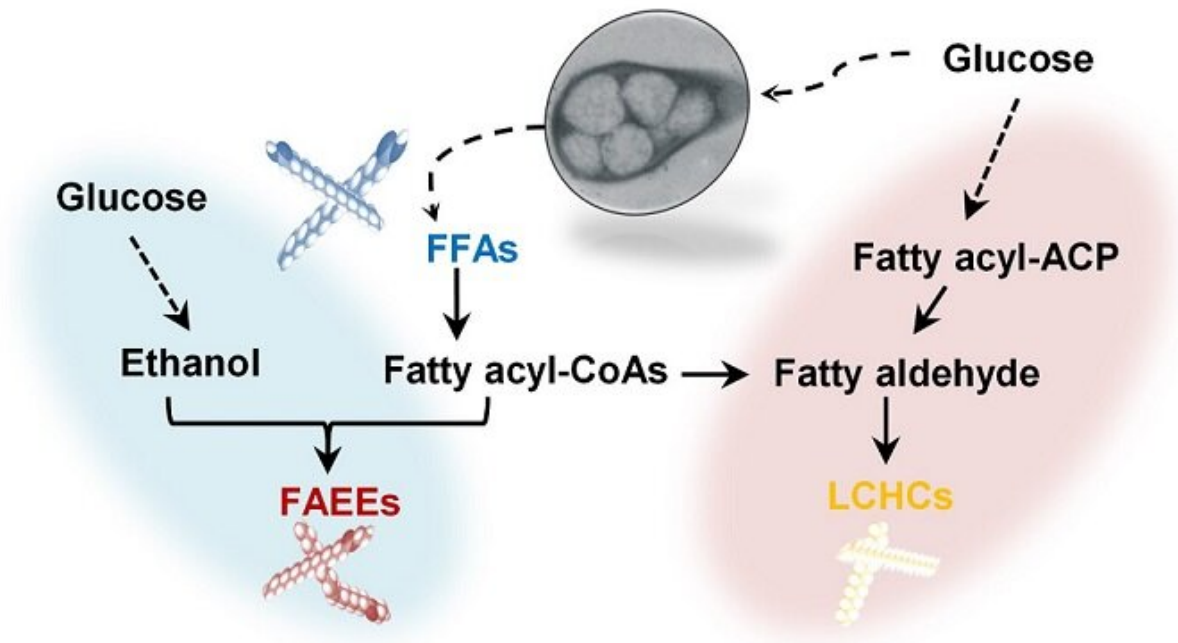


# Efficiently producing fatty acids and biofuels from glucose

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Metabolic engineering for the production of free fatty acids (FFAs), fatty acid ethyl esters (FAEEs), and long-chain hydrocarbons (LCHCs) in *Rhodococcus opacus* PD630. Researchers have presented a new strategy for efficiently producing fatty acids and biofuels that can transform glucose and oleaginous microorganisms into microbial diesel fuel, with one-step direct fermentative production. Credit: KAIST

Researchers have presented a new strategy for efficiently producing

fatty acids and biofuels that can transform glucose and oleaginous microorganisms into microbial diesel fuel, with one-step direct fermentative production.

The newly developed strain, created by Distinguished Professor Sang Yup Lee and his team, showed the highest efficiency in producing [fatty acids](#) and biodiesels ever reported. It will be expected to serve as a new platform to sustainably produce a wide array of fatty acid-based products from glucose and other carbon substrates.

Fossil fuels, which have long been [energy resources](#) for our daily lives, are now facing serious challenges: depletion of their reserves and their role in global warming. The production of sustainable bio-based [renewable energy](#) has emerged as an essential alternative and many studies to replace fossil fuels are underway. One of the representative examples is biodiesel. Currently, it is mainly being produced through the transesterification of vegetable oils or animal fats.

The research team engineered oleaginous microorganisms, *Rhodococcus opacus*, to produce fatty acids and their derivatives that can be used as biodiesel from glucose, one of the most abundant and cheap sugars derived from non-edible biomass.

Professor Lee's team has already engineered *Escherichia coli* to produce short-chain hydrocarbons, which can be used as gasoline (published in *Nature* as the cover paper in 2013). However, the production efficiency of the short-chain hydrocarbons using *E. coli* (0.58 g/L) fell short of the levels required for commercialization.

To overcome these issues, the team employed oil-accumulating *Rhodococcus opacus* as a host strain in this study. First, the team optimized the cultivation conditions of *Rhodococcus opacus* to maximize the accumulation of oil (triacylglycerol), which serves as a

precursor for the biosynthesis of fatty acids and their derivatives. Then, they systematically analyzed the metabolism of the strain and redesigned it to enable higher levels of fatty acids and two kinds of fatty acid-derived biodiesels (fatty acid ethyl esters and long-chain hydrocarbons) to be produced.

They found that the resulting strains produced 50.2, 21.3, and 5.2 g/L of fatty acids, fatty [acid](#) ethyl esters, and long-chain hydrocarbons, respectively. These are all the highest concentrations ever reported by microbial fermentations. It is expected that these [strains](#) can contribute to the future industrialization of microbial-based biodiesel production.

"This technology creates fatty acids and [biodiesel](#) with high efficiency by utilizing lignocellulose, one of the most abundant resources on the Earth, without depending on fossil fuels and vegetable or animal oils. This will provide new opportunities for oil and petroleum industries, which have long relied on [fossil fuels](#), to turn to sustainable and eco-friendly biotechnologies," said Professor Lee.

**More information:** Hye Mi Kim et al, Engineering of an oleaginous bacterium for the production of fatty acids and fuels, *Nature Chemical Biology* (2019). [DOI: 10.1038/s41589-019-0295-5](https://doi.org/10.1038/s41589-019-0295-5)

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